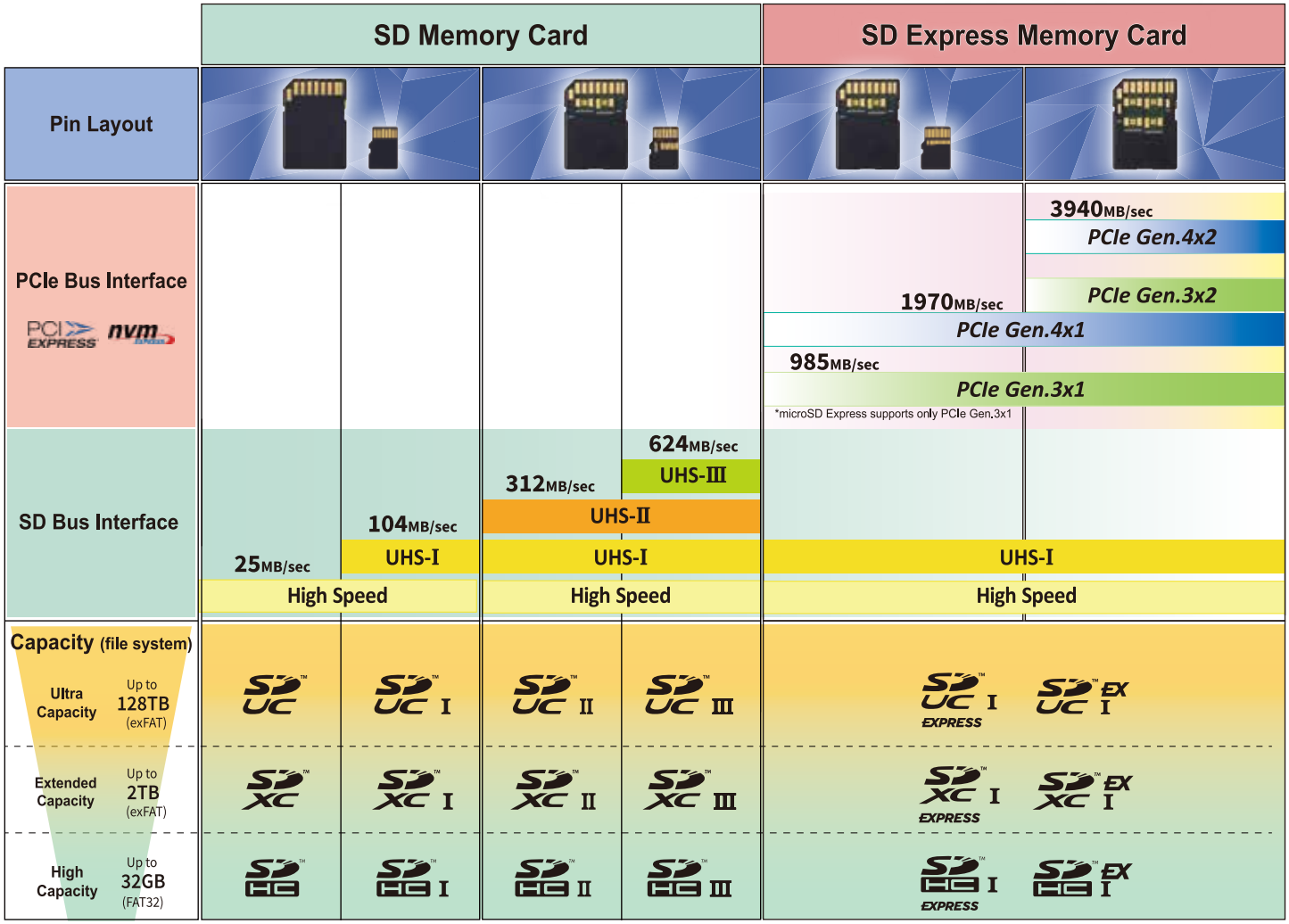
SD™
SD Standards —
Universal, High Performance Mobile Storage
SD™
SD Association

SD Standard and Bus Interface

SD specifications define a variety of memory card capacities, bus interfaces and Speed Classes, giving manufactures a great deal of flexibility in developing new products to satisfy any consumer need. The industry standard is used by a myriad of consumer and industrial devices expanding its application to various IoT and emerging new digital generation products like drones, VR, surveillance cameras, etc. Moreover, the cards feature outstanding interoperability and compatibility between devices. Expanding capacity with SDUC allows cards to reach capacities up to 128TB. SDUC, SDXC and SDHC memory cards can use new SD bus interface of UHS-III or SD Express, which deploys PCIe and NVMe technology, creating versatile, portable and convenient SD memory cards that continue to lead the removable flash memory card market for the evolving digital landscape.

SD Express

Next generation SD Express memory cards, serve as removable Solid State Drives (SSD), achieve speeds of up to 3940 MB/s with PCIe technology, maintaining its backward compatibility and performance, with the advanced NVMe protocol, delivers faster access to data files than today's SD platform. These cards support content applications and data generated by highly capable system architectures delivering speeds essential for high-resolution content applications such as super-slow motion video, RAW continuous burst mode and 8K video capture and playback, 360 degree videos, speed hungry applications running on cards and mobile computing devices, ever evolving gaming systems, multi-channel IoT devices, numerous automotive storage needs, to name a few.
The PCIe interface is added in addition to the existing SD UHS-I interface allowing a card with SD Express to operate in billions of existing SD host products in the market today.



FAT File System

SDUC standard increased memory capacity more than 2TB to an extremely high capacity of 128TB, dramatically altering the digital-user experience. Moreover, adoption of the exFAT file system has enabled recording of 4K and 8K videos and handling even larger files.

Host Device and Card Compatibility

Host Device \ SD Card	(2GB or less) FAT12/16	(Over 2GB to 32GB) FAT32	(Over 32GB to 2TB) exFAT	(Over 2TB to 128TB) exFAT
SD compatible	✓	N/A	N/A	N/A
SDHC compatible	✓	✓	N/A	N/A
SDXC compatible	✓	✓	✓	N/A
SDUC compatible	✓	✓	✓	✓

Speed Classes

Speed Class indicates a memory card's minimum write speed. This distinction is especially needed when recording video, which requires a constant minimum write speed. Users can find out the speed of a card by the clearly indicated Speed Class, UHS Speed Class and Video Speed Class mark.

V6 V10 V30 V60 V90

The new Video Speed Class compatible cards will indicate the symbols above

SD Speed Class And Video Format

Minimum Sequential Write Speed	Speed Class: Speed Class	Speed Class: UHS Speed Class	Speed Class: Video Speed Class	Corresponding Video Format: The necessary speed varies by each recording/ playback device condition. in the same format.
90MB/sec			V90	8K Video 7680 x 4320 pix; 4K Video 3840 x 2160 pix; HD/ Full HD Video 1920 x 1080 pix; Standard Video 640 x 480 pix
60MB/sec			V60	
30MB/sec		U3	V30	
10MB/sec	C10	U1	V10	
6MB/sec	C6		V6	
4MB/sec	C4			
2MB/sec	C2			

Application Performance Classes

With the expanded usage of SD memory cards for storing applications and application data, there is a growing need for a combination of Random and Sequential performance levels. This demand becomes even stronger with the introduction of Android's Adopted Storage Device capability. The Application Performance Class was introduced by SD 5.1 specification with the first App Performance Class 1 (A1), to address these new application-intensive market demands followed by Class 2 (A2). These new classes assure minimum random and sequential performance speeds to meet both run and store execution time requirements under given conditions, while still providing storage of pictures, videos, music, documents and other data.

Application Performance Class Specification Table

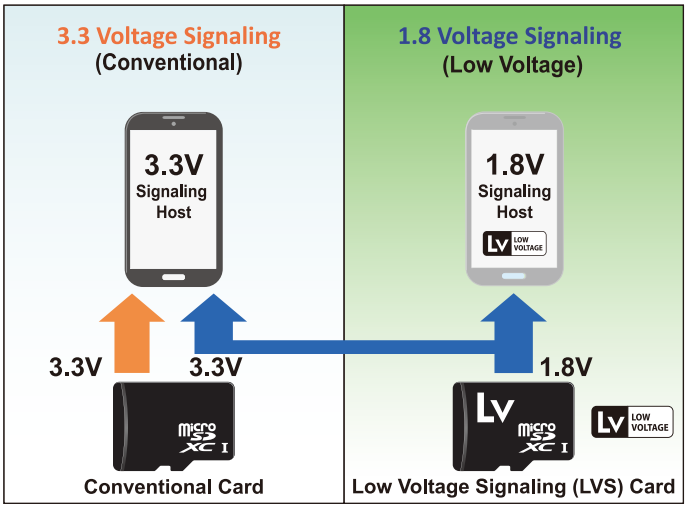
Application Performance Class	Pictograph	Minimum Random Read	Minimum Random Write	Minimum Sustained Sequential Write
Class 1 (A1)*	A1 APP PERFORMANCE	1500 IOPS	500 IOPS	10MBytes/sec
Class 2 (A2)**	A2 APP PERFORMANCE	4000 IOPS	2000 IOPS	10MBytes/sec

*The detailed preconditions and test are defined in SD 5.1 Part 1 Physical specification.
**The detailed preconditions and test are defined in SD 6.0 Part 1 Physical specification.

Low Voltage Signaling

This new feature lets product manufacturers take advantage of new SOC designs enabling smartphones to offer higher performance with less power consumption. While conventional SD memory cards have used 3.3V signaling interface, the new SD 6.0 specification introduces Low Voltage Signaling (LVS) with 1.8V signaling to let an LVS host device start in UHS-I mode directly, without 3.3V initialization process, after power up.
The LVS card is usable by both conventional hosts connected by 3.3V signaling and LVS hosts connected by 1.8V signaling. An LVS host cannot use conventional cards except when UHS-II mode is available.

Low Voltage Signaling Card Feature



SD Association

SD Card Formatter

SD Card Formatter is designed to optimize the performance of memory cards that conform to SD/SDHC/SDXC standards. Cards formatted with SD Card Formatter maximize its performance and Speed Class capabilities and exhibit increased compatibility between different devices.

Note:
SD memory cards formatted using a utility bundled with your computer may not perform optimally. SD Association recommends formatting SD memory cards using SD Card Formatter available for downloading it for free from our website.

Compatible Operating Systems

	SD/SDHC/SDXC
Windows	Windows 7, Windows 8, Windows 8.1, Windows 10 Version 1511, Windows 10 Version 1607, Windows 10 Version 1703, Windows 10 Version 1709, Windows 10 Version 1803, Windows 10 Version 1809, Windows 10 Version 1903, Windows 10 Version 1909, Windows 10 Version 2004, Windows 10 Version 20H2, Windows 10 Version 21H1, Windows 10 Version 22H2 (All 32/64-bit), Windows 11 Version 21H2 (64-bit)
Mac OS	Mac OS X 10.7 Lion, Mac OS X 10.8 Mountain Lion, Mac OS X 10.9 Mavericks, Mac OS X 10.10 Yosemite,Mac OS X 10.11 El Capitan, macOS 10.12 Sierra, macOS 10.13 High Sierra, macOS 10.14 Mojave, macOS 10.15 Catalina, macOS 11 Big Sur, macOS 12 Monterey Note: If you have a Mac with Apple silicon, e.g. M1, you might be asked to install Rosetta in order to open the SD Card Formatter.
Linux OS	Debian 10, x86_64, Debian 11, x86_64, Debian 11, ARM64/ Ubuntu 20.04, x86_64/ Raspberry Pi OS, ARM64 2022-04-07/ Fedora 35, x86_64, Fedora 35, ARM64/ Arch Linux, 2022.06.06 (5.17)

About the SD Association

Founded in January 2000 by Panasonic, SanDisk (now Western Digital) and Toshiba (now Kioxia), the SDA was dedicated to establishing SD as a standard for memory cards. Today, the SDA has grown from 14 members to more than 800 members focused on developing and promoting SDA specifications. Today, SD memory cards are the undisputed market leader and consumers first choice in cards.

Spec Version (Release Year)	Capacity & Form Factor	File System	Bus Interface	Speed Class	Others
2020-2022 Ver. 9.00 (2022) Ver. 8.00 (2020)			**SD Express PCIe Gen.4 x 1 Lane** **SD Express PCIe Gen.3 & 4 x 2 Lane** SD EXPRESS (Ver.8.00)		**Secure/Fast Boot** **TCG Storage Security** Trusted Computing Group® **RPMB** Replay Protected Memory Block New (Ver.9.00)*1
2018~2019 Ver. 7.10 (2019) Ver. 7.00 (2018)	SDUC microSDUC (Ver.7.00)	exFAT (Ver.7.00)	**SD Express PCIe Gen.3 x 1 Lane** SD EXPRESS (Ver.7.00) microSD EXPRESS (Ver.7.10)		**Low Voltage Signaling** LV LOW VOLTAGE (Ver.6.00)
2016~2017 Ver. 6.00 (2017) Ver. 5.10 (2016) Ver. 5.00 (2016)			**UHS-III** SDHC III SDXC III (Ver.6.00)	**Video Speed Class** V6 V10 V30 V60 V90 (Ver.5.00)	**App Performance Class** A1 (Ver.5.10) A2 (Ver.6.00)
2011~2013 Ver. 4.20 (2013) Ver. 4.00 (2011)			**UHS-II** SDHC II SDXC II (Ver.4.00)	**UHS Speed Class 3** 3 (Ver.4.20)	microSD EXPRESS (Ver.4.00) iSDIO Wireless LAN SD (Ver.4.20)
2000 ~ 2010 Ver. 3.01 (2010) Ver. 3.00 (2009) Ver. 2.00 (2006) Ver. 1.20 (2005) Ver. 1.10 (2004) Ver. 1.01 (2000)	SDXC microSDXC (Ver.3.00)	exFAT (Ver.3.00)	**UHS-I** SDHC I SDXC I (Ver.3.01)	**UHS Speed Class 1** 1 (Ver.3.01) CLASS 10 (Ver.3.00) CLASS 6 CLASS 4 CLASS 2 (Ver.2.00)	SMART (Ver.2.00)
	SDHC microSDHC (Ver.2.00)	FAT32 (Ver.2.00)	**Default Speed DS** (Ver.1.01) **High Speed HS** (Ver.1.10)		
	SD (Ver.1.01) microSD (Ver.1.20)	FAT12/16 (Ver.1.01)			

*1 Targeted for embedded or semi-embedded applications supporting through SD Intereface and/or PCIe interface (SD Express) cards.

Note: SD and related marks and logos are trademarks of SD-3C LLC. © 2022 SD-3C LLC. All Rights Reserved. Copyright © SD Association. All Rights Reserved.

www.sdcard.org

Printed 2023 - May